Designation: D 4825 – 97 (Reapproved 2002)

An American National Standard

Standard Test Method for Measurement of Curl in Cut-Sized Office Paper[1]

This standard is issued under the fixed designation D 4825; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the measurement of curl in cut-sized office papers at ambient conditions. The test method would typically be used in evaluating papers described in Specification D 3460 or after processing in a copier or printing device.

1.2 Cut-sized office papers are generally described as having dimensions of 8½ by 11 in., 8½ by 13 in., 8½ by 14 in., and 11 by 17 in.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 528 Test Method for Machine Direction of Paper and Paperboard[2]

D 585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Products[2]

D 685 Practice for Conditioning Paper and Paper Products for Testing[2]

D 3460 Specification for White Watermarked and Unwatermarked Bond, Mimeo, Spirit Duplicator, Reprographic and Laser Printer Cut-Sized Office Papers[2]

D 5039 Test Methods for Identification of Wire Side of Paper[2]

3. Summary of Test Method

3.1 A lift of approximately 10 to 20 sheets of paper are removed from a sealed ream and the curl is measured noting the axis, direction, and magnitude of the curl.

3.2 The tests can be conducted at 50 % relative humidity or at ambient conditions if it is carried out quickly.

4. Significance and Use

4.1 Curl in cut sized paper plays an important part in how paper performs in its intended use. Frequently cut-sized papers are used in duplicators and copy machines operating at high speeds. Inherent curl, that is, curl in the ream before entering the process and curl developed during the imaging process, can affect its performance, especially if duplexing (two-side printing) or collating is involved. Common problems experienced include jamming and misregistration.

4.2 The experience used in developing the test method was limited to uncoated writing papers in the commonly used cut sizes. The technique is basic and could be used with coated papers as well as paperboard to identify the type and magnitude of curl.

4.3 The test method identifies the type and degree of curl in a pack of sheets and does not address variations that might be inherent in individual sheets. If during the testing process it is observed that one or more sheets reacts in a contrary manner to the lift, it should be noted. Curl of a single sheet may not necessarily be determined by this procedure.

5. Apparatus

5.1 *Curl Gage*—A curl gage can be developed which consists of a straight line 216 mm (8½ in.) long and companion arcs each 216 mm (8½ in.) long of a radius such that the distance between the arc and the chord intersecting the arc circumference at the 216-mm (8½-in.) length is 10 mm, 15 mm, 20 mm, and 30 mm. An example of such a gage is shown in Fig. 1.

NOTE 1—Copies made on a xerographic copier of the curl gage should not be used because those devices frequently have a built-in enlargement which would change the dimensions of the arcs. A curl gage can be developed using the following relation between the distance between the chord and the arc and the arc radius.

[1] This test method is under the jurisdiction of ASTM Committee D06 on Paper and Paper Products and is the direct responsibility of Subcommittee D06.92 on Test Methods

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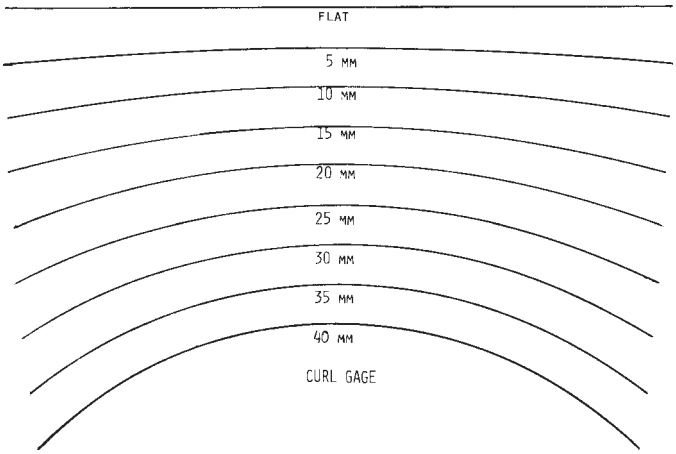
[2] *Annual Book of ASTM Standards*, Vol 15.09.



NOTE 1—Not to scale.
FIG. 1 Curl Gage

Distance	Radius
5 mm	116.5 cm
10 mm	58.0 cm
15 mm	38.6 cm
20 mm	28.8 cm
25 mm	22.9 cm
30 mm	18.9 cm
35 mm	16.0 cm
40 mm	13.9 cm

5.2 *Measuring Device*— A measuring device can be fabricated that resembles the letter *T*. The horizontal member is 216 mm (8½ in.) long. The vertical member is a rule calibrated in millimetres and mounted so as to be able to slide in the vertical position. This allows the distance between the end of the rule and the straight edge of the horizontal member to be determined. An example of such a fixture is shown in Fig. 2.

6. Sampling

6.1 Select packages of cut-sized paper in accordance with Practice D 585.

6.2 When measuring paper from unopened packages, open the package, pull out 10 to 20 sheets from the pack, and make the measurement in 5 min or less after the sheets are removed from the pack. Do not pull sheets from the top or bottom of the pack.

6.3 When measuring paper from stacks that are not wrapped, pull 10 to 20 sheets from one distance down into the stack so as to avoid paper that has been exposed to the ambient environment.

6.3.1 Identify paper as to machine direction using Test Method D 528 and felt and wire side using Test Methods D 5039. If the paper has been processed in a copier or printing device, note the imaged side. If both sides are imaged, note the side imaged first.

6.4 When measuring paper after copying or duplicating, pull 10 to 20 sheets form the machine and make the measurement.

7. Conditioning

7.1 When the test method is to determine the curl inherent in the paper, conditioning at the normal temperature and humidity is not appropriate. Conduct the test, however, either under conditions described in Practice D 685 or under conditions in which the paper will be used.

7.2 When the test method is used to determine the curl developed during an imaging process, conduct the determination of curl in the ambient conditions of the imaging device.

8. Procedure

8.1 Suspend the pack of 10 to 20 sheets with the thumb and forefinger in the middle of the paper edge of the short dimension about 10 mm from edge. Immediately measure the curvature of the pack using either the curl gage or the measuring fixture.

8.1.1 In using the curl gage, match the curvature of the pack to the appropriate arc on the gage and record the value which represents the distance between the chord and the arc of the curvature.

8.1.1.1 In using the fixture, position the two ends of the straight edge and move the ruler so as to touch the inner edge of the arc formed by the curvature of the paper. Measure the distance in millimetres between the chord (straight edge) and the arc.

8.1.2 Record the direction of the curl, that is toward the felt or wire side. A felt side curl is one in which the edges curl toward the felt side. A wire side curl is one in which the edges curl toward the wire side.

8.1.3 Record the axis of the curl as one of the following:

8.1.3.1 *Machine-direction Curl*—Curl axis parallel to the machine direction of the sheet.

8.1.3.2 *Cross-direction Curl*—Curl axis parallel to the cross direction of the sheet.

8.1.3.3 *Diagonal Curl*—Curl axis at approximately 45° to the machine direction.

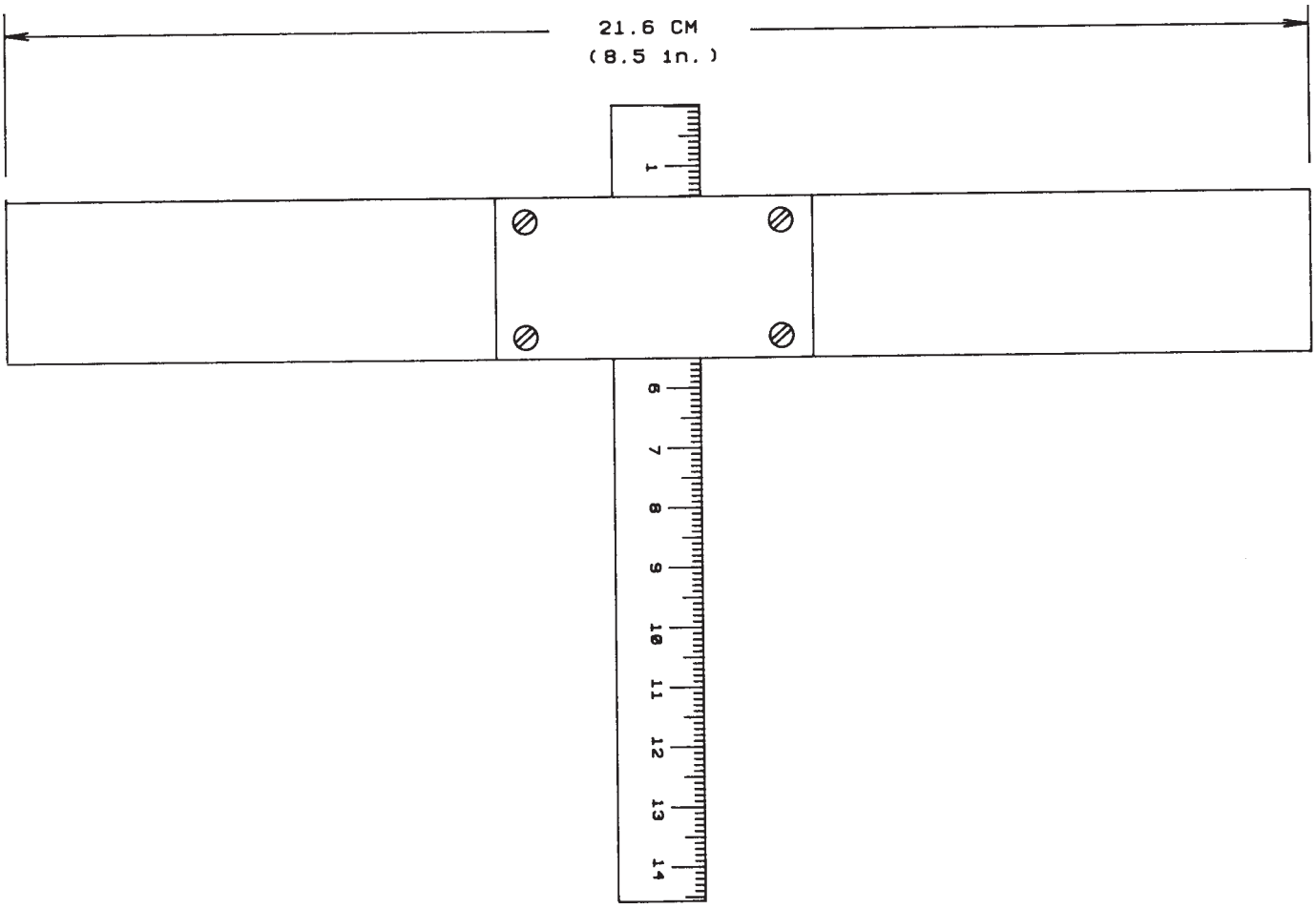


FIG. 2 Measuring Device

8.1.4 A flipper curl is one which tends to alternate between the felt and wire direction with a light manipulation of the pack.

NOTE 2—Flipper tendency is a phenomenon that may be described as two complimentary curl patterns being finely balanced within the same ream. For instance, the in-ream curl test may reveal both a machine direction felt side and a cross direction wire side curl on the same pack. The flipping tendency may be observed by "snapping'' the pack. If the direction and magnitude change very readily, it is considered a "flipper.''

8.2 Repeat the test for the long dimension, that is, hold the pack on the upper edge of the long edge and determine the direction and magnitude of curvature.

8.3 The magnitude of curl is always expressed as millimetres between the arc and the chord for a 216-mm (8½-in.) arc, regardless of the dimension being tested.

9. Report

9.1 Record full identification of the paper as to grade, type, basis weight, dimension, and other pertinent information.

9.2 Record ambient conditions.

9.3 Report the axis, side, and magnitude of the curl in accordance with the following sample:

Machine Direction–Felt Side–10 mm

9.4 Report any flipping tendency.

9.5 On specimens that have been imaged, in addition to the information required in 9.3, report the side imaged or in the case of duplexing, the side imaged first.

10. Precision and Bias

10.1 The precision and bias of this test method have not been determined.

11. Keywords

11.1 copier paper; curl; cut-sized paper; office cut-sized paper; paper; printing paper